Expanding the Use of Weather Forecast Products for Fire Management Decision-Makers

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Potential For Extending Fire Weather Index (FWI) Forecasts

Multiple Days of Forecast Daily FWI Codes

Station	Date	Hr	ATF	RHP	WSM	PREC	FFMC	DMC	DC	ISI	BUI	FWI	DSR
Last Observed Record													
◊ DON	07-29	14	77	47	3	0	90.7	36.2	394.2	6	59.1	16.8	4
◊ DRY	07-29	14	82	31	1	0	91.8	34	346.8	6	54.8	16.8	3.7
◊ GDP	07-29	14	72	54	10	0	89.1	38.6	367.4	8.4	61.2	21.8	6.4
◊ JCK	07-29	14	77	44	4	0	90.9	26.1	346.1	6.7	43.9	15.5	3.5
◊ OKL	07-29	14	70	61	11	0	87.9	29.9	389.8	7.7	50.2	18.5	4.8
◊ PABI	07-29	14	74	48	12	0	90.1	39.8	390.9	11	62.9	26.8	9.1
Day 1 Forecast													
◊ DON	07-30	14	82	40	3	0	90.7	40.3	403	6.1	64.7	17.7	4.4
◊ DRY	07-30	14	81	33	0	0	89.9	38.4	355.4	4.2	60.5	12.9	2.5
◊ GDP	07-30	14	78	40	7	0	90	42.3	375.7	7.5	66.1	21	5.9
◊ JCK	07-30	14	79	42	2	0	90.9	29.8	354.5	5.8	49.2	14.7	3.2
◊ OKL	07-30	14	75	48	7	0	88.3	33	397.8	5.9	54.6	15.9	3.6
◊ PABI	07-30	14	74	45	6	0	90.1	42.5	398.8	7	67.2	20.1	5.5
Day 2 Forecast													
◊ DON	07-31	14	81	36	2	0	91.1	44.2	411.6	5.9	70.3	18.1	4.6
◊ DRY	07-31	14	82	28	4	0	92.5	43.3	364.1	8.4	66.7	22.8	6.9
◊ GDP	07-31	14	77	33	8	0	91.2	46.3	383.9	9.7	71.4	26.1	8.8
◊ JCK	07-31	14	81	37	2	0	91	34	363.1	5.8	53.1	15.7	3.5
◊ OKL	07-31	14	77	37	6	0	90.2	36.8	406	7.2	60	19.3	5.1
◊ PABI	07-31	14	74	40	5	0	90.2	46	406.7	6.4	71.7	19.5	5.2
Day 3 Forecast													
◊ DON	08-01	14	86	27	2	0	93.1	49.4	420.0	7.9	76.3	23.3	7.2
◊ DRY	08-01	14	84	22	8	0	94.2	48.1	372.3	14.8	72.7	35.1	14.8
◊ GDP	08-01	14	82	26	4	0	93.0	50.7	391.9	9.1	76.9	25.9	8.7
◊ JCK	08-01	14	85	29	3	0	92.7	38.4	371.4	8.0	61.1	21.1	6.0
◊ OKL	08-01	14	80	30	6	0	92.0	40.0	413.8	9.3	65.5	24.2	7.7
◊ PABI	08-01	14	80	29	4	0	92.1	50.0	414.5	7.7	76.9	23.1	7.1

Calculation of daily forecast estimates depicting forecasts for groups of stations.

Reported Record

Date Hr	ATF	RHP	WSM	PREC	FFMC	DMC	DC	ISI	BUI	FWI	DSR
07-27 14	72	46	2	0.00	88.6	42.3	322.0	4.2	63.7	13.3	2.7
07-26 14	70	39	8	0.00	88.7	39.3	314.3	6.8	59.9	18.6	4.8
07-25 14	69	39	5	0.05	85.1	36.2	306.7	3.2	55.8	9.0	1.6
07-24 14	74	42	6	0.00	89.3	33.0	299.3	6.3	51.8	16.1	3.7
07-23 14	75	41	5	0.00	88.8	29.7	291.4	5.4	47.4	13.7	2.8
07-22 14	75	40	3	0.00	85.2	26.3	283.4	2.7	42.6	7.3	0.9
07-21 14	65	51	7	0.05	69.9	22.7	275.4	1.1	37.7	2.5	0.1
07-20 14	62	70	6	0.23	45.0	20.5	268.4	0.1	34.4	0.2	0.0
07-19 14	60	92	2	0.20	40.0	32.1	275.5	0.8	49.7	0.1	0.0
07-18 14	73	37	4	0.00	90.4	48.5	280.5	6.3	67.8	18.6	4.8
07-17 14	73	45	7	0.00	90.5	45.0	272.7	7.9	63.7	21.3	6.1

3-Day Forecast

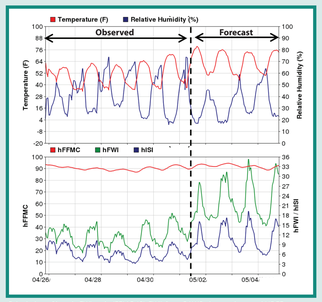
Date Hr	ATF	RHP	WSM	PREC	FFMC	DMC	DC	ISI	BUI	FWI	DSR
07-30 14	78	39	4	0.00	92.1	55.8	347.9	8.0	79.7	24.1	7.6
07-29 14	81	33	12	0.00	93.0	52.0	339.7	12.3	75.2	33.4	18.1
07-28 14	85	27	6	0.00	92.9	47.5	331.0	10.5	69.9	27.3	9.5

Calculation of daily forecast estimates depicting multiple forecast days with recent history for a single station.

Whether one day or several days, displaying forecasts beside the most recent observations allows us to compare forecasts to what we know happened "yesterday".

Would this help you in planning readiness and incident response?

Observed and Forecast Hourly FWI Codes

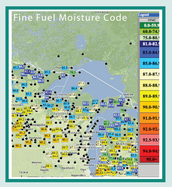


Calculation of hourly FWI code (FFMC, ISI, FWI) from RAWS observations and NDFD forecasts.

With hourly data that is already being collected at the Alaska Interagency Coordination Center (AICC), diurnal (24-hr) trends of Fine Fuel Moisture Code (FFMC), Initial Spread Index (ISI), and Fire Weather Index (FWI) can be plotted. These trends, if extended to include forecasted codes and indices based on forecasted weather, could improve awareness of:

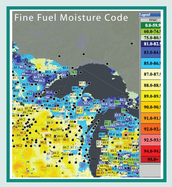
- Weather changes forecasted to occur after the 1400 daily observation,
- Influence of overnight factors such as poor humidity recovery on coming fire potential,
- Expected length of the burn period and duration of past and upcoming wind events,
- Periods of "Crossover", where severe fire behavior is indicated,
- How grass fuels respond to sun, wind, and temperature/humidity changes that occur hour to hour during the peak burning conditions later in the day. Calculation of the Grass Fuel Moisture Code (GFMC) is only possible with hourly data.

Daily "Observed" and Forecast FWI Grids - a Lake States Example



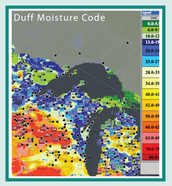
Paintballs versus Paintings

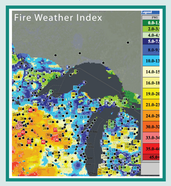
Gridded maps of daily FWI codes have proven useful in the Lake States where similarly uneven patterns of summer precipitation and local winds aren't captured by widely spaced weather stations. Weather forecasts now provide the necessary elements to calculate FWI codes for thousands of locations, or grid cells, each day. That requires similar grids of "observed" weather that can provide yesterday's fuel moisture codes for the calculations.

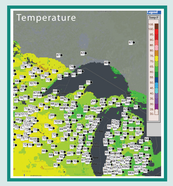


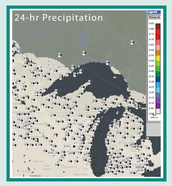
"Observed"

Grid of "observed" daily FWI codes and indices would require using weather elements from the Real-Time Mesoscale Analysis (RTMA) and the Quantitative Precipitation Estimate (QPE).



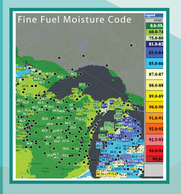


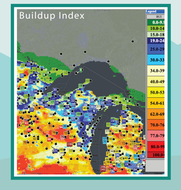


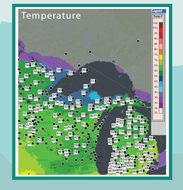


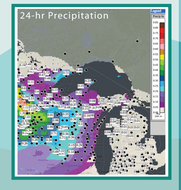
Forecast

Forecasted FWI grids require elements from the National Digital Forecast Database (NDFD), the Quantitative Precipitation Forecast (QPF) and grids of "yesterday's" fuel moisture codes.







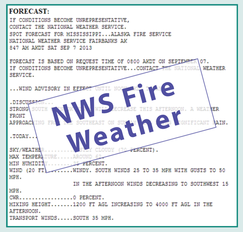


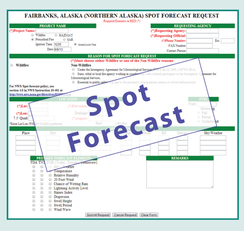
Examples taken from Great Lakes Fire and Fuels - glffc.utah.edu.

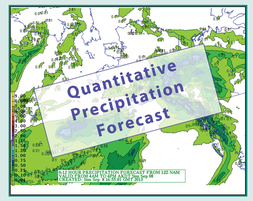
Current Assessment Products

(Available on AICC Predictive Services Web Pages)

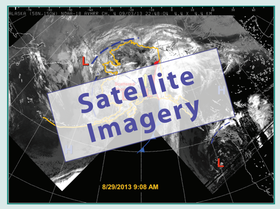
Short-term forecasts critical for today's operations

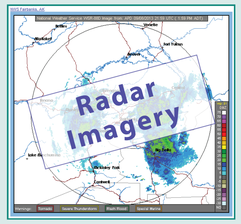


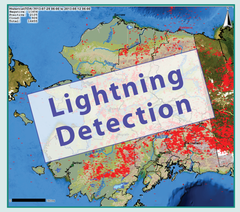




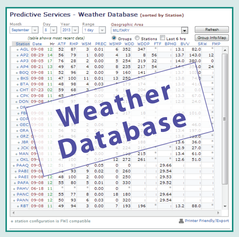
Spatial depictions of recent events

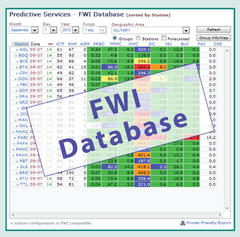


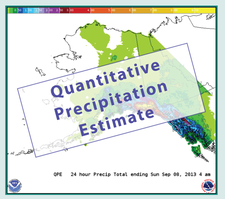




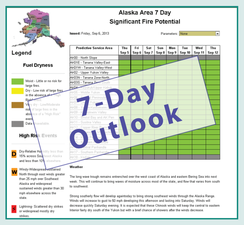
Databases of recorded weather and associated FWI calculations

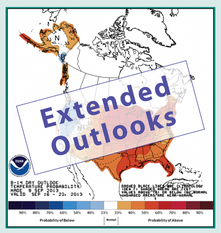


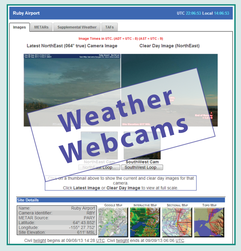




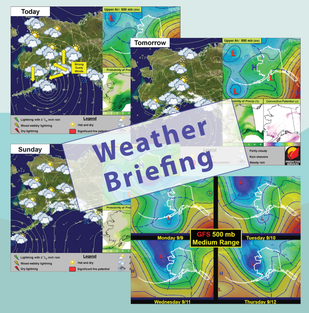
Outlook Products and other Remote Sensing Tools







Daily Fire Weather Briefing



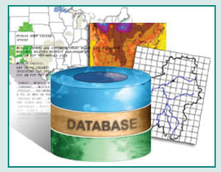
Delivered each morning by AICC Predictive Services after consultations with National Weather Service Meteorologists and fire managers, the Fire Weather Briefing incorporates the products shown here into a summary of expected weather and fire potential for the next 7 days.

Extending forecasted Fire Weather Index products as suggested here could help focus attention on areas of significant fire potential, as well as the weather conditions that drive them, over the entire 7-day period.

Spatial depictions on statewide maps, many of which are based on National Digital Forecast Database (NDFD) weather forecast products, provide the backdrop for the bulk of these briefings. Though not site specific, they are critical to strategic planning each day.

Users understand the increasing uncertainty with weather forecasts for days 2-7, yet continue to use them to interpret and assess upcoming fire potential. Leveraging them into additional forecasted FWI codes and indices is a natural next step.

Untapped Sources for FWI Forecasts

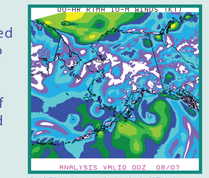


National Digital Forecast Database

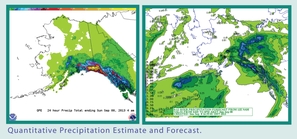
The National Weather Service's National Digital Forecast Database (NDFD) divides Alaska's 586,412 square miles into 42,189 6km cells, each of which contains its own forecasts. If we exclude as many as ½ of these as unimportant to fire, that still leaves 21,094 useful forecast cells. Each contains 40 forecasts spread over a 7-day (168 hour) window, resulting in 843, 778 individual forecasts that are updated twice each day. AICC currently produces only one FWI forecast (for the current day) for approximately 100 locations/cells, or less than 0.012% of the forecasts available. ***Should we try to use more?***

What is RTMA and how might we use it?

The Real-Time Mesoscale Analysis (RTMA) was developed as a tool for validating NDFD forecasts. It is intended to provide grids of "observed" weather elements like temperature, dew point, and windspeed. Grids like this would be needed to initialize fuel moistures each day if FWI codes and indices were to be forecasted for all grid cells in the NDFD.



Real-Time Mesoscale Analysis (RTMA).



Quantitative Precipitation Estimate and Forecast.

Detailed Alaska Precipitation Reports and Forecasts

With only a small portion of Alaska monitored by NOAA NEXRAD radar, the River Forecast Center uses a variety of information to produce Quantitative Precipitation Estimates (QPE) and Forecasts (QPF). These can be used to produce gridded estimates of both actual and forecast 24-hour precipitation, which are needed to produce the FWI forecasts.

Data Availability and Quality Concerns

Each of the opportunities for increased use of forecasts raises issues that need to be evaluated so that processes and data can be accepted, adapted or rejected.

- Currently forecasted codes are limited to the number of locations that NWS forecasters can manually evaluate and edit while preparing the fire weather planning forecast each day. Expanded use of NDFD forecast elements would come at the cost of losing that human touch. Wind and precipitation forecast errors could have large potential impacts.
- Forecasts beyond the first 24-48 hours are known to be much less accurate and complete. Is there value in forecasting FWI codes from these forecasts?
- Extending use of forecasts beyond day 1 forecasts would require expanding the database for storage of additional forecasts (day 2-day 7) and updates to facilitate periodic validation of results.

Comparing forecasts to subsequent obervations is important to any forecast system - users need to understand the quality of a forecast when using the information.

The Choices We Face

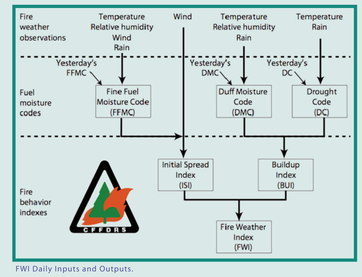
The CFFDRS Fire Weather Index (FWI) system implemented in Alaska, through its dependence on a simple set of weather elements and "yesterday's" moisture codes, can leverage expanded use of NDFD forecasts.

Temperature

Relative Humidity

Wind

Rain



FWI Daily Inputs and Outputs.

The four pieces we need to make this all work - if we can get this then we can provide a whole range of forecasts.

We could:

1. Combine NDFD forecasts with daily observations from all weather station locations to produce more forecast locations and multiple days of forecasted FWI for each.
2. Calculate hourly forecasts of FWI values for FFMC, ISI, FWI, and even the new Grass Fuel Moisture Code, which may improve our understanding of danger in grassland fuels.
3. Employ RTMA/QPE and NDFD/QPF grids to produce one or two days of FWI forecasts painted across the landscape.

Forecast accuracy and data integrity issues need to be clearly understood. The choice is yours.

How do you want to use the forecasts that are available?